lower side of said tube bundle, and with the end portion of the tubes, extending beyond the tube plate itself. The corrosive attack of ammonium carbamate has a particularly great impact on weldings between tubes and tube plate, with them being quickly compromised.

For the protection of the tube bundle against such a corrosive action, each tube thereof is generally coated on the inside with a layer of zirconium, as is the outer wall of the tube plates, above all the lower one.

However, despite the recognized effectiveness of the zirconium coating against the chemical corrosion determined by the aforementioned agents, the techniques provided up to now to equip the tube bundles of heat exchangers of the type considered with such a coating have not allowed completely satisfactory results to be achieved. Indeed, the well known "incompatibility" of zirconium with both carbon and stainless steel, as regards a close bonding of them through welding, is such that in anti-corrosion coatings (zirconium/steel) realized with the prior art, cracks, damages or, in any case, points and zones in which the desired coating is inexistent, occur. This, for example, frequently occurs and above all for the outer coating zones (zirconium) of the tube plate that surround and are in contact with the outer wall (steel) of the tubes tied in it and supported by it.

Besides this, the objective difficulty of manufacturing a zirconium coating on steel tube bundles makes the current production techniques of heat exchangers of the type considered here difficult to actuate, very expensive and with "products" being obtained that require frequent checks and frequent maintenance interventions.

A tube bundle apparatus for processing corrosive fluids is disclosed in WO-A-03/095060.

CLAIMS

1. Apparatus for treating highly corrosive agents, comprising a tube bundle (14) heat exchanger (10), structured to carry out a heat exchange between two fluids one of which is highly corrosive and flowing inside of said tube bundle (14), characterized in that said tube bundle (14) comprises at least one titanium or titanium alloy tube (14a), coated with a layer (25) of zirconium or zirconium alloy bonded to said tube (14a) metallurgically or through welding.

2. Apparatus according to claim 1, characterized in that said at least one titanium or titanium alloy tube (14a) is coated on the inside by said zirconium or zirconium alloy layer (25).

3. Apparatus according to claim 1, characterized in that said at least one titanium or titanium alloy tube (14a) has a thickness between 1.0 and 10 mm, and in that said zirconium or zirconium alloy coating layer (25) has a thickness between 0.3 and 2.0 mm.

4. Apparatus according to claim 1, characterized in that said at least one titanium or titanium alloy tube (14a) is only partially coated with said zirconium or zirconium alloy layer (25).

5. Apparatus according to claim 4, characterized in that

said zirconium or zirconium alloy layer (25) coats solely an end portion (14b) of said heat exchange tube (14a).

6. Apparatus according to claim 3, characterized in that said zirconium or zirconium alloy layer (25) extends in said at least one titanium or titanium alloy tube (14a) starting from an entry end (26) towards an opposite end (27) thereof, for a portion between 5 and 30%.

7. Apparatus according to claim 1, characterized in that said at least one titanium or titanium alloy tube (14a) and said zirconium or zirconium alloy coating layer (25) are bonded together through hot-drawing.

8. Apparatus according to claim 1, characterized in that said heat exchanger (10) comprises respective upper and lower tube plates (15, 16) for supporting said tube bundle (14), said tube plates (15, 16) being made of titanium or titanium alloy, or being coated with a titanium or titanium alloy layer.

9. Apparatus according to claim 8, characterized in that said upper and lower tube plates (15, 16) are made of carbon or stainless steel, coated on the outside with a layer of 3-15 mm of titanium or titanium alloy.

10. An apparatus according to claim 1, which is a stripper for the decomposition of ammonium carbamate in an urea production plant.

11. An apparatus according to claim 1. which is a condenser for the condensation of ammonia and carbon dioxide into ammonium carbamate in an urea production plant.